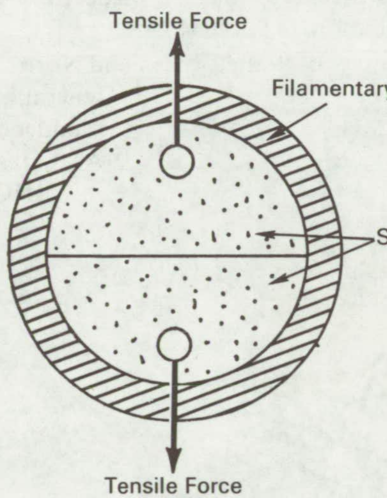
NASA TECH BRIEF

Testing Filamentary Composites



Cross Sectional Views

Figure 1. Schematic of NOL Ring Split-Dee Tensile Test.

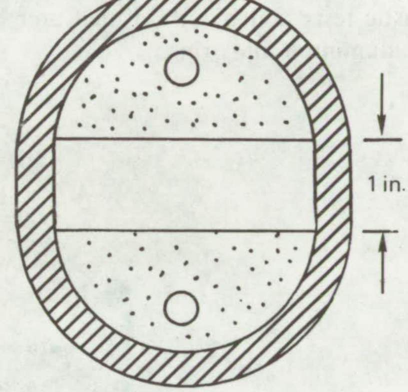


Figure 2. "Race-Track" Filament-Wound Tensile Specimen.

The testing of filamentary composites to determine their mechanical properties has proved to be more difficult than the testing of homogeneous materials such as metals. The difficulties take several forms: they may derive from discontinuities encountered in specimens designed to provide a diminished cross-section, as is often done to avoid failures at points of load introduction; they may be associated with the shear weakness of the binder, leading to undesired modes of failure; or they may arise because a type of test known to be inadequate is used for economy or other reasons. In this study some of the aspects of the NOL ring split-dee tensile test are examined, both analytically and experimentally, in an effort to adapt this technique to the structural testing of filamentary composites.

The NOL ring split-dee tensile test, shown in Figure 1, has the advantages that the specimen may be readily fabricated by winding, and the test may be performed in a conventional universal testing machine without special fixtures other than the split-dees themselves. The test has the disadvantages, however, that (1) no test section is available at which strain gages may be mounted to measure the stress-strain properties, and (2) more seriously, the test introduces substantial bending moments in the ring where the split occurs between the two dees. Because the membrane stress in the ring causes it to increase in diameter as the load increases, the ring tends to pull away from the corners of the dee, and the maximum bending moment is that associated with the load times the deflection to the center of the ring cross-section near the corners of the dees. These bending moments are of a sufficient magnitude to raise questions about the validity of the test data.

In attempts to eliminate the bending moment, a straightaway section was added adjacent to the split in the dees (Figure 2). A mathematical analysis was

(continued overleaf)

made of this "racetrack" specimen and a comparison of the results with the ring specimen indicates that, while bending is not eliminated by the straightaway section, it is substantially reduced. Even a relatively short section, i.e., a 1-cm straightaway, reduces the bending moment to less than one-half that of the circular ring. A qualitative understanding of the mechanics of the reduction of the maximum bending moment is gained by realizing that the midpoint of the straightaway, when loaded, deflects inward toward the center of the track. Even though the curved portions pull away from the dees, the eccentricity of the tensile load at mid-span is small and therefore, the moment associated with it is also small, i.e., the maximum moment occurs at the corners of the dees and not at the midspan.

Experimental confirmation of a qualitative nature of this analysis of split-dee tests was obtained by photoelastic tests and by strain measurements on an enlarged aluminum-alloy ring.

Note:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65).

Reference:
NASA-CR-66518 (N68-13962), Design Criteria and Concepts for Fibrous Composite Structures

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: B. Walter Rosen and Norris F. Dow of
General Electric Co.
under contract to
NASA Headquarters
(HQN-10268)